# FLASHING OPERATION

The controller should start up in the phase which has indications that flash yellow during flash operation, this is normally phase 2. If a signal flashes all red, the controller should start up in the main line phase, again this is usually phase 2.

As an energy and fuel consumption conservation measure, traffic signals may be placed on **programmed flashing operation** during those hours when volume warrants are not satisfied if the following conditions are met:

- The artery normally displays a flashing yellow during flash
- There are no sight line restrictions from the side streets
- No special feature of the signal requires continuous operation

Traffic signals that flash all red should not be placed on programmed flash. Stopping all vehicles all the time does not conserve fuel.

**Traffic signal maintenance level** is based upon safety, such as restricted sightlines from the side streets or a strong need for full operation outside normal working hours, such as high volumes during hours outside normal maintenance periods. Any recommendation for maintenance level will be reviewed by the Office of Maintenance & Highway Operations - Division of Highway Operations. On consultant designs, the maintenance level will be provided to the consultant engineer by the Division of Traffic Engineering.

# PRE-EMPTION

Pre-emption is a feature used to modify a traffic control signal to grant right-of-way to emergency vehicles, trains or a specific traffic movement to meet a special need. This can be accomplished by modifying timing, sequence or display.

When the pre-emption sequence is actuated, adequate clearance intervals must be provided to insure safe stoppage of vehicles, or clearances from railroad tracks or draw bridge spans. Pedestrian clearance intervals may be shortened in order to provide track clearance display. At the end of the pre-emption sequence, control is normally returned to the artery phase. However, this must be specified on the plan.

## Emergency Vehicle Pre-Emption

Emergency vehicle pre-emption causes the traffic signal controller to advance to, and/or hold a desired traffic signal pre-emption phase. Some methods used to activate emergency vehicle pre-emption are hardwire, coded light transmissions and radio signals. They require an 8-phase controller that has the internal pre-emption capability and are described below.

**Activated Over Hardwire**

This system employs a physical connection to identify the presence of designated priority vehicle(s). The system requires a cable from the controller to an activation switch. The switch is located at the source of an emergency call (such as a fire station). Railroad Pre-Emption uses this method and is subsequently discussed in this manual.

**Optical Light Transmission Activated**

This system employs optical communication to identify the presence of a designated priority vehicle (such as fire apparatus). The system components required are:

1. Optical Emitter - A high-intensity electronic (strobe) light emitting device mounted on the emergency vehicle.

2. Optical Detector - A directional electronic device which "sees" the coded signal from the Emitter on the emergency vehicle from a distance up to 550 m (1800 ft).

3. Phase Selector - An electronic unit which is interfaced with the traffic signal controller. This unit receives the pre-emption call from the detector and sends the command to the controller, which engages pre-emption.

**Radio Activated**

This system employs a radio signal to identify the presence of an Emergency vehicle.

**Siren Activated**

This system employs the emergency vehicle's siren to identify the presence of a priority vehicle. Directional microphones detect when and from which direction an emergency vehicle approaches an intersection. The system is adjustable for vehicle range and also for audible signature, such as yelp, wail, and high-low. This system detects all federally-approved Class A sirens eliminating the need for a new transmitter on each vehicle.

## Pre-Emption Definitions

Parent Phase

For the purposes of pre-emption it is the phase the controller is in when a call for pre-emption is received.

Priority (yes/no)

A priority **yes** pre-emption call will override all other priority pre-emption calls (regardless of priority number). Railroad pre-emption is always **yes**. A **no** is used for all other pre-empt phases and priority is determined by its number.

Detector Lock (yes/no)

Similar to vehicle detector lock. If **yes**, a call that is dropped during the delay time will still be serviced. If **no**, a call that is dropped during the delay time will not be serviced.

Delay (seconds)

The time between when the pre-emption call is received and the start of the pre-emption movement. Usually used with hardwire pre-emption where the emergency station is a distance from the signal. Not needed with optical pre-emption.

Alternate Minimum Green (seconds)

The interval time for a phase green which is timing when pre-emption begins. For example, if the controller is 2 seconds into a green interval and the Alt. Min. Green is 5 seconds, then when pre-emption begins, the green will time down for 3 more seconds. Typical values would be 5 seconds for Fire or EMS and 0 seconds for Railroad. Note - The setting selected for pre-empt 1 will apply to all phases.

Alternate Minimum Yellow (seconds)

The interval time for yellow which is timing when pre-emption begins. **Parent** can be selected to time down the yellow value in the parent phase or timing can be selected to have an alternate yellow time. Under normal circumstances use **Parent**.

Alternate Minimum Red (seconds)

The interval time for red which is timing when pre-emption begins. **Parent** can be selected to time down the red value in the parent phase or timing can be selected to have an alternate red time. Under normal circumstances use **Parent**.

Alternate Pedestrian Clearance (seconds)

The interval time for PED CLR which is timing when pre-emption begins.

- If there is no exclusive pedestrian phase or if there is a concurrent pedestrian phase, select **NO**. This will result in a zero setting in most controllers.
- If there is an exclusive pedestrian phase or a case where the pedestrian clearance time is used to operate a Stop Ahead sign, select the actual pedestrian clearance time. If the signal is in a closed loop system do not use the **Call to non-actuated** or enter time in the walk and pedestrian settings for the coordinated phase.
- In special cases with exclusive pedestrian movements (railroad preemption) a lower than pedestrian clearance time may be selected.

Track Clearance Green (seconds)

The time for which a green indication is maintained in the track clearance pre-emption phase.

Track Clearance Yellow (seconds)

The time for which a yellow indication is maintained in the track clearance pre-emption phase.

Track Clearance Red (seconds)

The time for which a red indication is maintained in the track clearance pre-emption phase.

Hold Green (seconds)

The time for which a green indication is maintained in the pre-emption phase.

Hold Yellow (seconds)

The time for which a yellow indication is maintained in the pre-emption phase.

Hold Red (seconds)

The time for which a red indication is maintained in the pre-emption phase.

Hold Phase (1-8)

This is the phase which is called for pre-emption.

Exit Phase (1-8)

The phase(s) that will follow the pre-emption phase.

Exit Call (1-8)

The phase(s) that will have vehicle (or PED) call(s) for service when the pre-emption terminates. Exclusive PED phases and phases in non-lock should not be selected.

Only non-activated, such as internal clearances, should be selected.

Phases in lock mode retain vehicle and pedestrian calls that are present before pre-emption and received during pre-emption. Since the controller will serve these calls when pre-emption is released, specifying exit calls is normally not necessary.

## Pre-Emption Design Guidelines

1. The design will be for primary response routes only.

2. The pre-emption phase will be labeled **Pre-Empt** along with a number, which indicates the priority level. For example a #1 is the highest priority followed by 2, 3 etc. Six (6) is the maximum number of pre-emption phases per controller.

3. If the required pre-emption sequence is exactly the same as an existing phase, the existing phase should be used for pre-emption as well as phase movement. Add **Pre-Empt (#)** to the movement diagram, this signifies that the phase is also going to be used as a pre-emption phase. All sequences should use only parent phases and normal overlaps. If this is not done, incorrect indications may occur.

4. If the required pre-emption sequence is NOT exactly the same as an existing phase, an exclusive phase (Ex. Phase 8) must be added to the signal plan for pre-emption. The Mode for this pre-empt phase is **On/Omit**. Some controllers require the phase to be enabled in order to operate correctly and omitted to prevent cycling to the pre-emption phase during start-up or manual operation. This new phase will not include any interval timings.

5. Settings and interval timings for all pre-emption phase(s) shall be listed in an auxiliary block, on the traffic signal plan, below the signal faces. All the pre-emption data which will be programmed in the controller must be provided in this block. (see example blocks, timings are for illustration purposes only)

6. For Railroad pre-emption a Track Clearance phase is required. This phase will be serviced immediately and will time the track clearance green, yellow and red intervals prior to the controller transferring to the Railroad pre-emption hold phase (unless the track clearance phase is the railroad pre-emption hold phase). The track clearance settings and hold phase settings must be entered into Pre-empt 1. (see example blocks, timings are for illustration purposes only)

7. On the traffic signal plan, for EVPS (emergency vehicle pre-emption) only, add the technical note - **Pre-Emption to be Inoperative During Flashing Operation**. For Railroad pre-emption the need for this note will be determined on a case by case basis.

8. If the traffic signal is maintained by the state and has EVPS only, add the note **Pre-Emption Equipment to be Owned and Maintained by the Town of (list town)** to the signal layout.

9. If the traffic signal contains an exclusive Pedestrian movement in a coordinated system, the Call to Non Actuated feature will not be used. The coordinated phase green time will NOT be programmed in the walk & don't walk intervals. It will be programmed in the min-grn and max intervals.

10. The Department of Transportation will only maintain pre-emption equipment which operates on hardwire. The town will be required to provide maintenance on pre-emption equipment which operates on any other type of communications between the fire station or emergency vehicle and the traffic controller.

Sample Pre-emption Setting Blocks

| | | Railroad | Fire | |
|---|---|---|---|---|
| | | PRE-EMPT 1 | PRE-EMPT 2 | |
| | PRIORITY | YES | NO | |
| | DET LOCK | NO | YES | |
| | DELAY | 0 | 0 | |
| | ALT MIN GRN | 0*** | 5 | |
| | ALT YELLOW | Parent | Parent | |
| | ALT RED | Parent | Parent | |
| | ALT PED CLR | 0 | 0 | * |
| | TRACK CLR GRN | 15 | N/A | |
| ** | TRACK CLR YLW | 3.0 | N/A | |
| | TRACK CLR RED | 2.0 | N/A | |
| | HOLD GREEN | 10 | 15 | |
| | HOLD YELLOW | 3.0 | 3.0 | |
| | HOLD RED | 2.0 | 2.0 | |
| | HOLD PHASE | 8 | 2 | |
| | EXIT PHASE | 1 | 4 | |
| | EXIT CALL | None | None | |

* Or actual pedestrian clearance time if there is a pedestrian phase.

** Used only when there is a track clearance phase for railroad pre-emption.

*** To be determined by the railroad.

Hard-wire Fire Pre-emption

| | PRE-EMPT 1* | PRE-EMPT 2 |
|---|---|---|
| PRIORITY | NO | |
| DET LOCK | YES | |
| DELAY | 10 | |
| ALT MIN GRN | 5 | |
| ALT MIN YELLOW | PARENT | |
| ALT RED | PARENT | |
| ALT PED CLR | 12 | |
| HOLD GREEN | 25 | |
| HOLD YELLOW | 3.0 | |
| HOLD RED | 2.0 | |
| HOLD PHASE | 8 | |
| EXIT PHASE | 2 | |
| EXIT CALL | 4 | |

10 seconds delay
5 second alternate minimum green
Sequence has an exclusive pedestrian phase (Ped Clr = 12")
Times the parent phase yellow and red intervals entering pre-emption
Holds on phase 8
Exits to phase 2
Upon exiting a call is placed on phase 4 (not required if non-lock)

*Sample illustrates when PRE-EMPT 1 is **not** railroad pre-emption.

## Railroad Pre-Emption

Care should be taken at railroad crossings to preclude the possibility of a vehicle being trapped on the tracks when equipment is properly operating. The method of actuation should be designed with adequate "Fail - Safe" features. Where crossings are 60 m (200 ft.) or less from a signalized intersection, railroad pre-emption will usually be required. At signalized intersections where the rail crossing is greater than 60 m (200 ft.), but high vehicular volumes are expected, a queue analysis should be conducted to ascertain if pre-emption is required. Contact the Division of Traffic railroad liaison to determine extent of controls. Track circuit designs are normally provided by the operating railroad.

The following should be considered in railroad pre-emption design:

Clearance out of normal operation to pre-emption shall follow ConnDOT traffic controller specifications.

1. Railroad pre-emption will normally require the use of an 8 phase menu driven controller with internal pre-emption which will go directly into the pre-emption phase(s) which includes clearances.

   Contact Traffic Engineering's Electrical and Railroad units during the preliminary design to determine how pre-emption will be provided and what special requirements must be shown on the plan.

   The actual sequence and signal displays for railroad pre-emption must be approved by traffic engineering's electrical and railroad units, as well as the Department of Transportation Signal Maintenance Lab.

2. Railroad pre-emption consists of two separate traffic control device actuations. When the train hits the approach circuit the first actuation is to the traffic signal controller, which immediately advances the sequence to the track clearance phase, via controller interval pre-emption. After a pre-determined period, the second actuation is to the railroad warning devices, which must operate for 29 seconds prior to the train entering the crossing. The traffic signal track clearance time, to enable vehicles to move off the tracks, must be complete prior to the activation of the railroad warning devices. The total track circuit time required is the traffic signal track clearance time, plus the 29-second railroad warning device timing.

3. Depending on the type and class of rail line, two different types of train operations can occur at a grade crossing. They are a through move (traversing the crossing non-stop), and a stop and protect (the train must come to a stop for a pre-determined time period before preceding over the crossing). For stop and protect crossings controlled by a traffic signal, the controller is to provide 29 seconds of all-red clearance and way side signals shall be provided for the train which shall be part of the traffic signal operations.

4. Traffic signals containing railroad pre-emption will normally not be allowed to be placed on programmed flash.

5. Separate pre-emption sequences for pre-emption during fail-safe flash or emergency flash may be required depending on site conditions.

6. Traffic signals containing railroad pre-emption should be placed on 24-hour maintenance.

7. A track circuit timing block and a "Pre-Emption Settings" block should be shown on the signal plan.

8. A note should appear on the signal plan stating that the signal installer must coordinate the installation of the pre-empt interconnect cable from the traffic signal control box, to the railroad control box, with the operating railroad. Adjustments of the existing railroad track circuit and/or warning devices may be required depending on the railroad pre-empt design.

9. When a railroad crossing is located on the side street leg of a signalized intersection, the emergency / fail-safe flash should be an all red flash. This will provide gaps in artery traffic for side street vehicles to clear off the railroad crossing.